Space Weather Technical Forecast

Issued on Sunday 8 December 2024 at 00:21 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Daily Chance of M-class flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Moderate activity was observed at GOES16, initially peaking with an M2.3 flare at 07/1308UTC from AR3917 in the southeast, but later trumped by an M3.2 from AR3910 in the northwest at 07/2215UTC.

AR3917 is currently the most complex region on the disc, with a Dac/Beta-Gamma classification. Assessment as to the presence of any component Mt Wilson delta spots has been rendered difficult given the relatively lower resolution of GONG intensity and magnetograms versus SDO HMI - none have been confirmed.

There are now up to seven regions on the disc. There were no obvious major changes observed in the current front sided spot groups the period. Other regions of note included AR3816 and AR3912, which both appear to be simpler Zurich D-groups (when compared with AR3917).

No Earth-directed CMEs were observed in the last 24 hours, however there remain numerous large filaments on the disc, especially in the southeastern quadrant, with the largest of these now nearing the solar meridian to perhaps warrant closer attention.

Solar Wind / Geomagnetic Activity: Solar winds, as recorded at L1 by ACE, were reflective of a slow regime for the most part, although a Solar Sector Boundary Crossing (SSBC) occurred around 07/1800UTC. Recent rises in solar wind speed and decreases in density may yet reflect an unexpected entry into the fast wind from CH97/+ - this will become clearer in the coming hours, however geomagnetic activity is not expected to increase significantly.

The solar wind speed fell within Background levels from the high to low-300s of km/s. The solar wind density was Slightly Elevated, with periods near 20ppcc, perhaps indicating Earth is transiting the current sheet, or hinting at a close pass from a CIR, perhaps that from southern coronal hole 97/+. The IMF was Slightly Elevated at peak at 9nT, with a smaller-scale and erratic north-south component ranging between +5 and -4nT. The phi angle was mostly negative (towards the Sun), but underwent a lasting transition into a positive sector after 07/1800UTC.

The net result of the above solar wind measures was nevertheless for provisionally Quiet geomagnetic activity throughout.

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Energetic Particles / Solar Radiation: High energy proton flux observed by GOES18 was at Background levels.

High energy electron flux (greater than 2MeV) observed by GOES16 was at Normal Background levels.

The associated 24-hour fluence was below Active, and the 07/2359UTC observation was 1.73e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: There is a now slightly increased, but hereafter level daily 'Chance' of isolated M-class flares, with no significant sunspot region departures, but perhaps one imminent significant returning region.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs that feature in the forecast. Initially slow solar winds may give way to the fast wind from CH98/+ during day two (Monday 09 December), although any effect is likely to be muted given our proximity to the solstice.

Quiet geomagnetic conditions may give way to Active from day two, Monday 09 December, probably easing through midweek UTC.

Energetic Particles / Solar Radiation: There is a Slight Chance that the recent M3.2 may produce an S1-scale enhancement, giving a modest rise in the risk within day one (Sunday 08 December), otherwise high energy protons are expected to persist at Background levels.

High energy electron flux is expected to start within Normal Background levels, perhaps rising in the wake of the fast wind from CH98/+ but the 24-hour fluence is currently not envisaged approaching the Active threshold.

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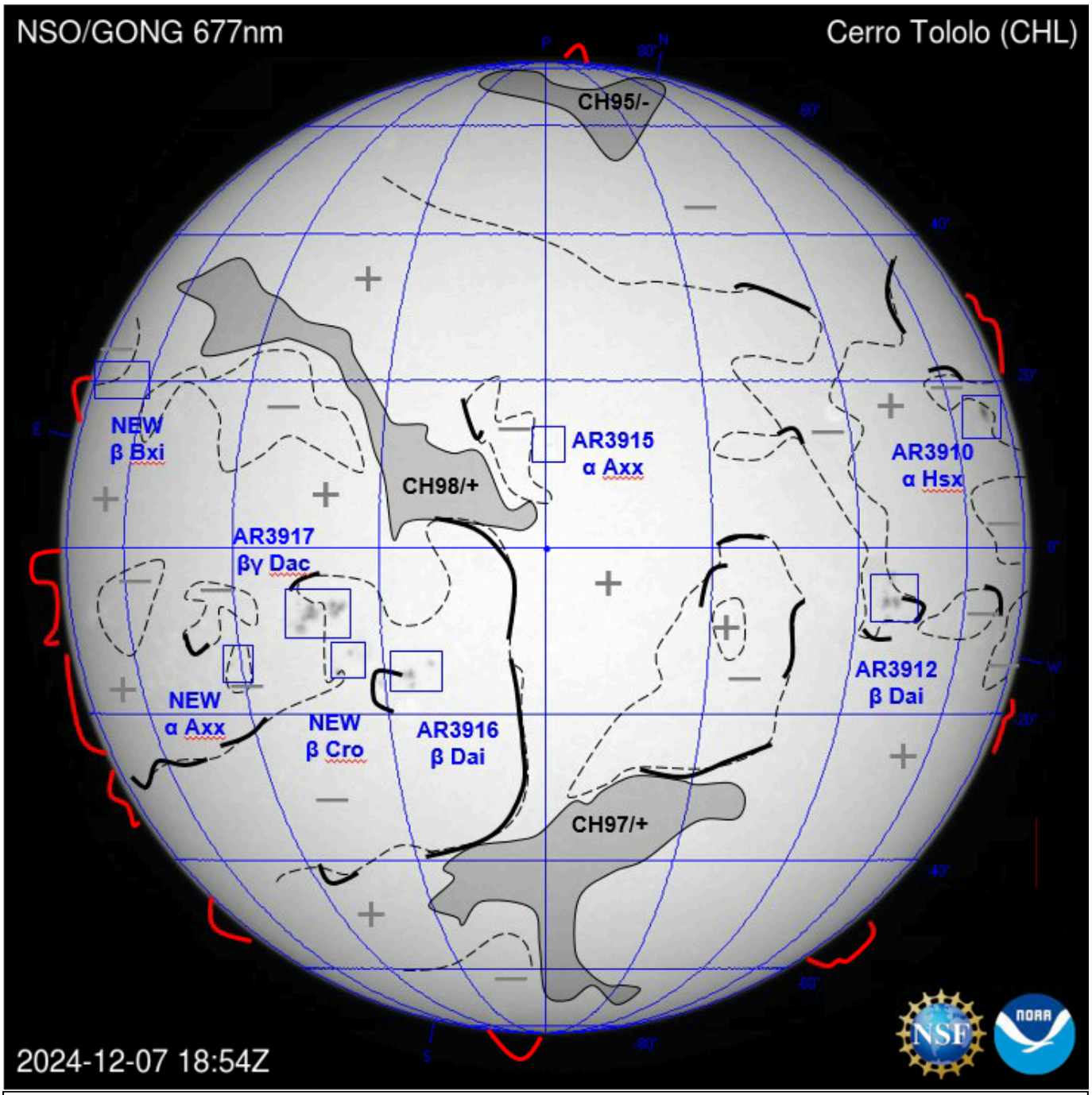
Figure 1: Solar synoptic map, valid 07/1855UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

No Earth-directed CMEs currently feature in the forecast.

Solar winds are expected to follow a slow regime at first, although the solar wind signature at ACE in the past 24 hours perhaps hints at a close pass to the south of a CIR associated with persistent CH97/+. Present thinking is that this is not expected to evolve into a fully-blown fast wind regime, however even if this does occur, geomagnetic activity is still expected to be subdued given the time of year (near the semi-annual minimum geoeffectivity of coronal holes of any polarity around the solstices). On the previous rotation, the solar wind reached a little above 400km/s, despite the coronal hole being located further north that time round.

A connection to the fast wind from CH98/+ is then most likely on Day 2, Monday 09 December. The latest MOSWOC Enlil run suggests a connection to this feature through 08 December, which is felt to be premature given its current presentation on the disc (narrowly into the western solar hemisphere).

All considered, Quiet geomagnetic conditions may give way to Active from day two, Monday 09 December, probably easing through midweek UTC.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	**G1 to G2**	No	1	1	1	1
Strong	**G3**	No	1	1	1	1
Severe	**G4**	No	1	1	1	1
Extreme	**G5**	No	1	1	1	1

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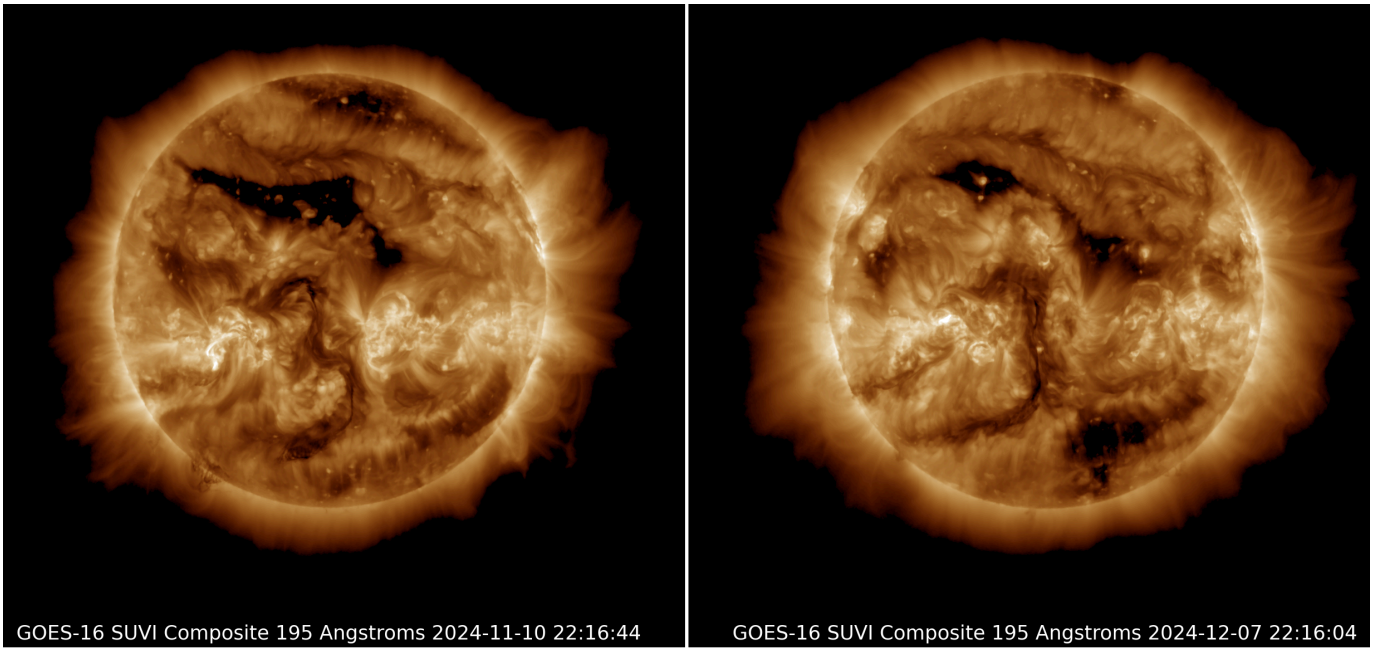
Figure 2: GOES16 SUVI 195 imagery of the previous and current iterations of CH97/+ (southern coronal hole) and CH98/+ (central northern). Although CH98/+ has slightly progressed on the disc relative to last pass, the stature of the portion near the solar equator remains similar and broadly similar effects are expected into the new UTC working week.



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Radio Blackouts - X-Ray Flares

Of the current front-sided sunspot regions, AR3917 in the southeast is perhaps most likely to produce M-class activity, and this region remains on the earth-facing side throughout the coming four days.

Regarding the balance of front-sided regions, no significant regions are due to depart the disc, however returning region Ex-AR3893 is due over the southeastern solar horizon inside the next 24 hours - this group produced M-class flares on its last pass. On balance, there is perhaps now a slightly higher Chance of M-class flares versus the recent past, with this risk soon rising and remaining constant through the period.

X-Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**R1-R2 (M Class)**	Yes	50	50	50	50
Very Active	**R3-R5 (X Class)**	No	5	5	5	5

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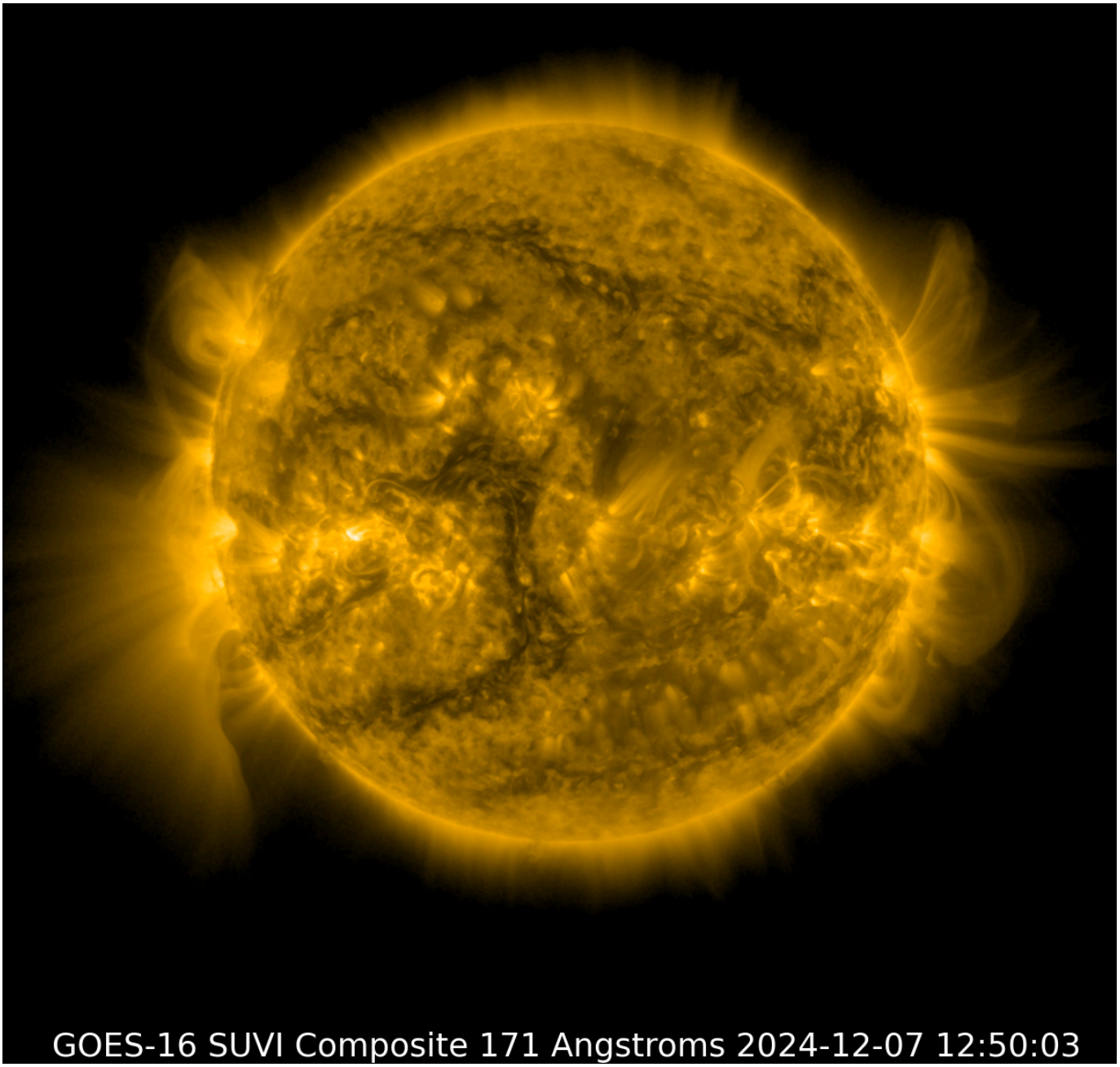
Figure 3: GOES16 SUVI 171 image showing flux looping from oncoming southeastern limb, presumed to be at least in part due to returning region Ex-AR3893.



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Solar Radiation Storms (High Energy Protons)

GOES18 proton flux is currently at Background levels, however there is a Slight Chance that the recent M3.2 may produce an S1-scale enhancement, giving a modest rise in the risk within day one (Sunday 08 December), otherwise high energy protons are expected to persist at Background levels. Many of the sunspot regions on the Earth-facing disc currently small and relatively simple, and the potentially generative more complex regions are well to the east.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons (≥ 2MeV)

High energy Electron flux observed by GOES16 has been at Normal Background levels, and is expected to remain so until after any fast wind from CH98/+, which may lead to electron flux reaching diurnally Moderate levels from Day 3, Tuesday 10 December.

The associated 24-hour fluence is expected to remain below Active levels, although a slight increase may occur before midweek UTC. The initiation of the uplift in fluence as indicated by MOSWOC REFM is considered too early, however overall MOSWOC REFM is considered reasonable guidance in its tendency to keep fluence below the Active threshold.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	1	1	5	10
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

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